CONFERENCING NETWORK RESOURCE OPTIMIZATION FOR MULTI-POINT CONFERENCES

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of Provisional Patent Application Serial No. 60/245,728 filed on November 2, 2000, entitled "Conference Network Resource Management And Optimization" and is also related to co-owned Patent Application Serial No._____, filed on November 2, 2001, entitled "Conferencing Network Resource Management For Call Connectivity" which are hereby incorporated by reference.

BACKGROUND

1. Field Of The Invention

[0002] The present invention relates generally to management of conferencing networks, and more particularly to applications for optimizing network resources for multi-point conferences.

2. Description Of The Background Art

[0003] H.323 is an umbrella recommendation from the International Telecommunications Union (ITU) that describes standards for multimedia communications over IP-based local area networks (LANs) that do not provide a guaranteed Quality of Service (QoS). Common LAN configurations utilize packet-switched TCP/IP and IPX over Ethernet, Fast Ethernet, and Token Ring technologies. Therefore the H.323 standards are commonly used in the implementation of enterprise videoconferencing networks.

[0004] Furthermore, conference requesters/initiators often want to include a relatively large number of participants in their conference call, i.e., more

participants than a single MCU is capable of facilitating. A common approach to this issue is to cascade, or connect, two or more MCUs together to increase the number of endpoints in a multi-point conference. This allows seamless integration of the conferences hosted by each MCU and the associated exchange of audio and video, with the cascaded nature of the conference typically being transparent to the conference participants, thus creating one unified conference. In addition, cascading MCUs optimizes the use of network resources. The task of cascading MCUs is currently accomplished manually, although it is a complex and non-user friendly operation, even for an experienced network administrator. Therefore, an additional need in the videoconferencing art is to simplify the use of cascading MCUs to optimize network bandwidth.

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SUMMARY

[0006] The present invention provides a cascade optimization module for determining an optimum configuration for cascading two or more multi-point control units together, consequently optimizing the local area network (LAN) and wide are network (WAN) links, bandwidth, and other resources. The multi-point control units may be centralized multi-point control units where each multi-point control unit includes a media controller (MC) integrated with a media processor (MP), or decentralized multi-point control units in which the MC is separate from the MP. The cascade configuration is also determined according to the network Quality of Service and connectivity policies maintained by the gatekeeper.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. 1 is a block diagram of an enterprise network, in accordance with the present invention;

[0008] FIG. 2 is a block diagram of gatekeeper, in accordance with the present invention; and

[0009] FIG. 3 is a flowchart of method steps for scheduling a conference call within a network.

DETAILED DESCRIPTION OF THE DRAWINGS

[0010] Scheduling and/or calendar applications are often used in enterprises, especially those with multiple campuses or work sites, in order to aid coordination of conferences or other collaborations among desired participants. These applications typically offer the ability to view the calendars of others on the enterprise network, as well as send conference invitations and subsequently update conference participant calendars upon acceptance of an invitation. Enterprises often use third party scheduling applications or may use proprietary applications developed for unique needs.

[0011] A method and system providing reliable connectivity of conference calls regulated by the H.323 audio and video conferencing protocol or Session Initiation Protocol (SIP) is first described. The system ensures that adequate network resources are available for a requested conference by binding an enterprise scheduling application with gatekeeper QoS/connectivity policies maintained by a network administrator. Through this conferencing network architecture, an endpoint can request network resources via the scheduling application, which can then access the gatekeeper policies and call authorization and management functionality. The gatekeeper can verify that adequate resources are available to complete the requested conference call and can ensure that the requested call is given priority over competing non-scheduled calls, thus ensuring successful initiation of the requested conference. Alternatively, the gatekeeper may be replaced by an SIP proxy in which scheduling applications (described below) are bound to the SIP proxy.

[0012] FIG. 1 depicts an exemplary operating environment of the system and methods described herein. An enterprise network 100 is depicted comprising at least two campuses, campus 1 and campus 2. Each campus comprises a LAN 102 interconnecting an MCU 104 and various workstations. The LANs 102 may utilize well-known technology such as Ethernet or any other suitable network technology, and employ appropriate communication protocols, for example TCP/IP. As is known in the art, an MCU supports conferences between three or more endpoints. An MCU typically includes a media controller (not shown) for, among other things, processing negotiations among endpoints and controlling audio, video, and multiplexed streams, and an optional media processor (not shown) for, among other things, processing, mixing, and switching of audio, video, and data signals. The scope of the present invention includes centralized and decentralized MCUs. A centralized MCU includes integrated media controller and media processor units. A decentralized MCU includes separate media controller and media processor units.

[0013] Each LAN 102 additionally interconnects one or more various videoconference-enabled devices, for example, a stand-alone videoconferencing unit (VCU) 106 such as the ViewStation™ MP available from Polycom, Inc. of Milpitas, California; a personal computer (PC) 108; and a PC/VCU 110 combination. The PC/VCU 110 is intended to depict a videoconference-enabled PC that is configured with a microphone, camera, speakers, and an associated conferencing application, or a PC coupled with a personal videoconferencing device such as the ViaVideo™ available from Polycom, Inc. of Milpitas, California. The devices coupled to the LANs 102 intercommunicate through an appropriate protocol such as TCP/IP, IPX, or any other

suitable communication protocol. Note also that the MCU 104 may not be a separate device as depicted in FIG. 1, but may be integrated into another device such as the VCU 106 or a network server 112.

[0014] The network server 112 includes a plurality of software applications and associated functions, and is coupled to the LAN 102 for communication with other network connected devices. The server applications may include, but are not limited to, a network management system 114, a gatekeeper 116, a resource scheduler 118, and optionally a gateway 120.

[0015] The network management system 114 manages the LAN 102 and connected devices. The network management system 114 manages hardware, for example, packet exchange monitoring and node diagnosis, and software, for example diagnosis and updating. An additional feature of the management system 114 is the capability to communicate and co-manage the resources of other network management systems 130 that reside on a service provider (SP) server 122. Exemplary functions include, but are not limited to, coordinating conference connectivity with the SP server 122 through a network 124 (preferably packet-switched), coordinating conference bandwidth management, and coordinating cascading of two or more MCUs 104 (or MCUs 128 resident at the SP server 122) together for expanding the number of endpoints in a multi-point conference.

[0016] The resource scheduler 118 is an application offering the ability, among others, to view and interact with the calendars of others on the enterprise network, as well as send conference invitations and subsequently update participant calendars upon acceptance of an invitation. In addition, the resource scheduler 118 is operative to communicate with the gatekeeper 116 upon a

conference request from endpoint devices VCU 106, PC 108 or PC/VCU 110. Although the scheduler 118 is depicted as resident on the network server 112, the invention is not limited to this configuration. The functionality of the scheduler 118 may also reside in the network management system 114, on any or all of the plurality of videoconferencing-enabled devices 106-110, or on any other workstation (not shown) on the LAN 102. The scheduler 118 is not only provided with access to the work calendars of enterprise personnel in order to coordinate the scheduling of meetings, conferences, etc., but is also provided with access to the gatekeeper connectivity policy, described below with respect to FIGs. 2 and 3. The communication between the scheduler 118 and the gatekeeper 116 facilitates the capabilities for reliable conference scheduling described herein. The gatekeeper 116 is described in detail below in reference to FIG. 2.

[0017] An optional gateway 120 may be present at the network server 112, for providing many services to network or LAN 102 endpoints such as 104-110. The gateway 120, is operative to provide interface functionality between different network types. As a network interface, the gateway 120 provides translation functionality between differing endpoints, including but not limited to translation between transmission formats, communications procedures, audio and video codecs, and possibly network address translation (NAT). In general, the gateway 120 facilitates communication between H.323 devices and analog PSTN (public-switched telephone network) devices. Thus, signal transmission between any or all of the LAN 102 connected devices 104-110 and the circuit-switched network 126 (i.e., the PSTN), may route through the optional gateway 120.

[0018] Finally, FIG. 1 depicts the network server 112 being optionally coupled to the SP server 122 through a network 124. The network server 112 and the SP server 122 may interoperate for various enterprise conference scheduling, MCU 104 cascading, bandwidth management, and other activities that may contribute to the successful integration and use of a service provider offering conferencing services.

[0019] FIG. 2 depicts in block format some of the functionality of the gatekeeper 116, in accordance with one aspect of the present invention. A QoS/connectivity policy (policy) module 202 maintains the enterprise network policies set by a network administrator. These policies are intended to describe the allowed capabilities of the network and the associated network devices 104-112 (FIG. 1), and may include, among other things, call authorization and management and network bandwidth management. Examples of policy rules include but are not limited to the speeds at which various devices 104-112 are able to transmit information over the LAN 102 to the packet-switched network 124 (FIG. 1), and/or to the circuit-switched network 126 (FIG. 1); designation of which devices 104-112 at each campus are allowed to communicate with which other devices 104-112 at each campus; and designation of services that are available to various devices 104-110. Another relevant example of a gatekeeper 116 policy is the priority assigned to various types of information transmission (e.g., audio, video, data, and e-mail) that may be competing for network resources, and the amount of network bandwidth that is allocated for such transmissions. Further, policies likely differ at various times of a day and of a week.

[0020] A bandwidth management/control module (BWM) 204 is provided for supporting, among other things, bandwidth request, confirm, and reject messages; for determining whether adequate bandwidth is available to complete a call; for determining if adequate bandwidth is available upon a request for additional bandwidth from an active call; and related functions. In addition, the BWM 204 communicates with and receives inquiries and requests from the scheduler 118 (FIG. 1) based upon a conference call request from a user. The gatekeeper 116 and the scheduler 118 intercommunicate through a scheduler interface module 206, which is operative to facilitate transfer of information therebetween. In addition, the gatekeeper 116 and the network management system 114 (FIG. 1) intercommunicate through a network management interface module 208, which facilitates transfer of information therebetween.

[0021] The gatekeeper 116 is further provided with a call authorization/management module (CM) 210 that is capable of communicating with the BWM 204 and supplying information thereto. Through the CM 210, the gatekeeper 116 may maintain a list of ongoing calls and it may restrict access to network resources for certain network devices 104-110 (FIG. 1) during certain periods of time. As a result of being able to communicate with the resource scheduler 118 (FIG. 1) through the scheduler interface 206, the gatekeeper is operative to manage network resources based on call requests made through the scheduler 118 and based on the policies defined by a network administrator in the policy module 202. In addition, MCUs 104 and endpoints 106-110 within the gatekeeper 116 zone register with the gatekeeper 116 when attempting to place a call, and the gatekeeper 116 has access to network configuration information describing

the LANs 102 and the devices 104-110. Thus, being privy to all of this information, the gatekeeper functionality described above is employed to ensure that sufficient network resources (i.e., bandwidth, etc.) are available to reliably connect and complete a scheduled conference call, and/or to accept or reject competing ad hoc call attempts.

[0022] The interaction between the gatekeeper 116 and the resource scheduler 118 is not limited by the configuration as described. Those skilled in the art may appreciate that alternate gatekeeper 116 configurations and functions, and additional intercommunication between the gatekeeper 116 and the scheduler 118, may provide reliable network bandwidth management and thus reliable connectivity for conference calls initiated in a network. These alternatives are thus considered within the scope of the present invention.

[0023] Another component of gatekeeper 116 is a cascade optimization algorithm 212, which is described below in reference to FIG. 3.

[0024] FIG. 3 is a flow diagram depicting a method for scheduling a conference call within a network, wherein sufficient network resources are ensured to provide a successful conference initiation. The method depicted also includes the method of the present invention for gatekeeper-based dynamic cascading of MCUs, wherein utilization of network resources is optimized.

[0025] At step 302, users at the devices 106-110 (FIG. 1) request a conference call, which is received by the resource scheduler 118 (FIG. 1). The request is routed to the gatekeeper 116 (FIG. 1) at step 304, whereby the requested conference registration with the gatekeeper 116 is initiated. The QoS/connectivity policy module 202 is accessed at step 306.

[0026] Since the devices 104-110 have previously registered with the gatekeeper 116 (FIG. 1) and the relevant network segments for the devices are known, the BWM 204 (FIG. 2) is capable of determining whether there are sufficient network resources available to successfully connect the requested conference call based on the policies defined in the policy module 202 (FIG. 2). The BWM 204 does this in step 308.

[0027] If sufficient resources are unavailable at the requested time and the requested conference configuration, the resource scheduler 118 (FIG. 1) is notified at step 310. The scheduler 118 then notifies the conference requester at step 312. In optional step 314, the scheduler 118, in conjunction with the gatekeeper 116, suggests an alternate conference time to the requester, again according to the known network capacities and policies. Users at the devices 106-110 (FIG. 1) may repeat the request for a conference call at step 302.

[0028] If it is determined at step 308 that sufficient network resources are available to complete the requested conference call, then the scheduler 118 schedules the requested conference and the appropriate invitations may be transmitted to conference invitees in step 316. At step 318, the CM 210 (FIG. 2) is notified to reject any competing ad hoc conference calls that may attempt to register with the gatekeeper 116 (through scheduler 118 or via direct connection attempts), if necessary. Additional features may include notifying connected ad hoc callers shortly prior to the initiation of the scheduled call, whereupon the availability of network resources for the ad hoc call will expire. For example, a message may appear on their monitor indicating that only five minutes remain for their current call.

Those skilled in the art can appreciate that a number of additional similar features may be integrated into the basic architecture described herein, and that such features are within the scope of the present invention.

[0029] The method for gatekeeper-based dynamic cascading of MCUs of the present invention begins at step 320. This portion of the method further contributes to the optimization of network resources. For example, if endpoint devices 106-110 (FIG. 1) connected to the LAN 102 (FIG. 1) in campus 1 want to participate in a conference managed by an MCU 104 (FIG. 1) connected to LAN 102 in campus 2, without cascading the campus 1 devices would typically connect "directly" to the MCU 104 of campus 2, thus unnecessarily consuming MCU resources (e.g., ports and processing power). On the other hand, if the participating endpoint devices 106-110 in campus 1 connect to the MCU 104 on their campus LAN, which in turn connects to the MCU 104 of campus 2, then only one port per MCU 104 is utilized to transmit one audio/video stream between campus 1 and campus 2. Therefore, overall network bandwidth usage and delay are reduced.

[0030] An improvement over the current manual method of cascading MCUs 104 (FIG. 1) is to provide a method and system for dynamically cascading MCUs according to gatekeeper 116 (FIG. 1) QoS and network resource utilization policies. Returning to FIG. 3 at step 320, the network management system 114 (FIG. 1) is notified (through the network management interface module 208 of FIG. 2) and provided relevant network management information to assist in global management of the networks, i.e., LANs 102 (FIG. 1). Included in this information are parameters related to the scheduled meeting, such as the identity of participating endpoint devices 106-110, the meeting time, the identity of the

utilized MCU 104, the required bandwidth, and the like. From this information, it is determined whether dynamic cascading is required for resource optimization, step 322. If it is determined that cascading is not required, then the conference call endpoints can be successfully connected at the scheduled time, step 328, and the call is essentially guaranteed the resources necessary for a successful conference.

[0031] If it were determined at step 322 that dynamic cascading would benefit the optimization of network resources, then the gatekeeper 116 (FIG. 1) is notified of such, at step 324. The gatekeeper 116 is provided with a cascade optimization algorithm 212 (FIG. 2) for determining an optimum cascade configuration from a multiplicity of possible configurations. Information utilized by the optimization algorithm 212 includes, but is not limited to, network scheduling information (from the resource scheduler 118), gatekeeper 116 policy information related to the participating devices (e.g., devices 106-110 and MCU 104) and network segments (from the QoS/connectivity module 202), and network configuration information.

[0032] Upon determination of an optimal cascading configuration, the network management system 114 (FIG. 1) is operative to direct the participating devices and MCUs to dial into the appropriate ports, thus economizing the limited WAN (i.e., network 124 of FIG. 1) and LAN 102 links, bandwidth, etc.

[0033] Although the embodiments are described in a specific operating environment and in a configuration in which the gatekeeper 116 is separate from the network management system 114, it is contemplated that the gatekeeper 116 and management system 114 functionality may be configured in a single application (which may also

include the resource scheduler 118). Further, although the cascade optimization module 212 is described as residing in the gatekeeper 116, it is contemplated that the cascade optimization module 212 and its related functionality could also and/or alternatively reside in the network management system 114 (if separate from the gatekeeper 116). Those skilled in the art may appreciate that the inventions described herein may be practiced in various application configurations without diverging from the scope of the invention.

[0034] Finally, as depicted in the exemplary operating environment of FIG. 1, the enterprise networks (campus 1 and campus 2 and network server 112) may be coupled to a service provider 122 through a network 124, preferably a packet-switched network. It is therefore further contemplated that the functionality described above, both the system and methods for reliable connectivity management (generally, scheduling of conference calls through a scheduler 118 bound to the gatekeeper policy 202 of FIG. 2) and the system and methods for resource optimization (generally, dynamic cascading of MCUs 104 according to gatekeeper policy 202), may be provided at either the enterprise level, the service provider level, or a combination of both. For example, services provided by the SP may include a videoconferencing service, whereby the SP populates its customer enterprises with appropriate videoconferencing devices, provides the network resources required for the audio, video, and data transmission from the LANs to and through a WAN (i.e., the Internet), and manages/controls conferences requested by enterprise personnel. To this end, it is envisioned that network management systems 130 (which may be a variation of network management system 114) are provided for the service providers 122, and that

the network management systems 114 and 130 intercommunicate to co-manage network resources. As long as the SP management system 130 has access to the enterprise MCUs and gatekeeper policy (and any SP MCU 128 and gatekeeper policy), then the scheduling and cascading may be managed and controlled remotely.

[0035] It will be recognized by those skilled in the art that, while the invention has been described above in terms of preferred embodiments, it is not limited thereto. Various features and aspects of the above-described invention may be used individually or jointly. Further, although the invention has been described in the context of its implementation in a particular environment and for particular applications, those skilled in the art will recognize that its usefulness is not limited thereto and that the present invention can be utilized in any number of environments and implementations.